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(54) High-precision printing machine, particularly for fabrics or the like, with multiple printing stations

(57) A printing machine, particularly for fabrics or the like, with multiple printing stations, comprising a belt-like supporting element (2), which is controllably movable along an advancement direction (3), for the fabric (4) or the like to be printed. A first printing station (6) and at least one second printing station (7,8,9) are provided along the extension of the belt-like supporting element (2) and are mutually spaced along advancement direction of the belt-like supporting element. The machine comprises registration means located on the belt-like supporting element (2) and means (16) for detecting the registration means which are associated with the printing stations (6-9). At least the second printing station (7) is controllably movable along the advancement direction (3) of the belt-like supporting element (2) so as to position itself with respect to the belt-like supporting element (2) according to the detection of the registration means on the part of the detector means so as to produce, on the fabric (4), a print in a preset position with respect to the print produced by said first printing station (6).

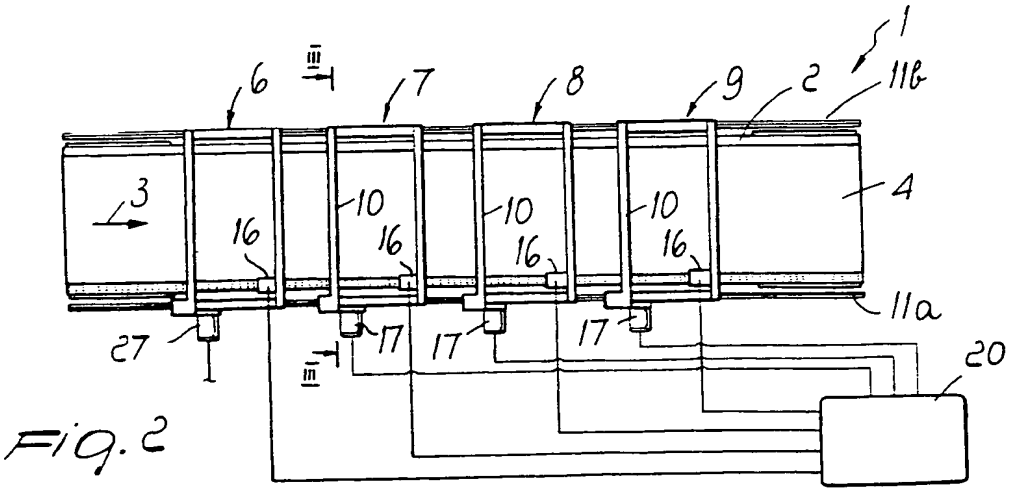

Fig. 2

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The present invention relates to a printing machine, particularly for fabrics and the like, with multiple printing stations.

It is known that patterns in various colors are currently printed on fabrics by means of printing machines that comprise a belt-like supporting element, actuated intermittently along an advancement direction, and a plurality of printing stations that are mutually spaced along the advancement direction of the belt-like supporting element.

The multiple color pattern is produced by means of successive printing operations, applying a single color in each printing station.

One of the main problems of printing performed with these machines is the correct execution of the printing operations carried out in the stations that follow the first one. In order to achieve a good result, that is to say, to achieve high-quality printing, the printing operation performed in the subsequent stations must be positioned perfectly on the fabric with respect to the printing operations performed in the previous stations, so that unwanted overlaps or gaps between the variously colored regions of the pattern to be produced do not occur.

In order to solve this problem, in machines in which the belt-like supporting element winds around two parallel rollers, at least one of which is motorized, there are control devices that cause the supporting element to advance by strictly identical successive steps. Such devices are generally constituted by readers that monitor the rotation of the driving rollers of the belt-like supporting element, or by readers that detect the advancement of the supporting element, correcting, if necessary, the action of the motor on the driving rollers. In order to avoid as much as possible misalignments during printing, particular care is taken in rigidly coupling the fabric to the belt-like supporting element.

The various printing stations are furthermore mounted on a supporting framework so that they can be adjusted in the direction along which the belt-like supporting element advances, so as to allow to correct their position before the printing process begins.

Despite these solutions, the problem of printing precision has not been solved completely, since accidental changes in the length of the belt-like supporting element can occur during the operation of these machines due to the intrinsic elasticity of the supporting element, to temperature variations, to friction between the belt-like supporting element and the underlying supporting surface, and to the deformation caused by the rotational stress, and due to other causes that are difficult to take into account during the setting of the machine.

It should be noted that, since the belt-like supporting element is considerably long (usually 20 to 80 meters long), a very small percent variation in its length leads to errors during printing that are unacceptable in high-quality fabrics.

In order to obviate this drawback, it is necessary to constantly monitor the printing quality with several manual adjustments of the position of the printing stations. These actions, in addition to being troublesome for the operators, significantly reduce the productive potential of these machines.

An aim of the present invention is to solve the problems described above by providing a printing machine, particularly for fabrics or the like, that is capable of ensuring high printing precision even in case of accidental variations in the length of the belt-like supporting element.

Within the scope of this aim, an object of the invention is to provide a printing machine that does not require continuous manual interventions for adjusting the position of the printing stations.

Another object of the invention is to provide a printing machine that ensures high productivity.

This aim, these objects, and others which will become apparent hereinafter are achieved by a printing machine, particularly for fabrics or the like, with multiple printing stations, comprising: a belt-like supporting element, controllably movable along an advancement direction, for the fabric or the like to be printed; a first printing station and at least one second printing station that are mutually spaced along said advancement direction; characterized in that it comprises registration means located on said belt-like supporting element and means for detecting said registration means which are associated with said printing stations; said at least one second printing station being controllably movable along said advancement direction so as to position itself with respect to said belt-like supporting element according to the detection of said registration means on the part of said detector means so as to produce, on the fabric, a print in a preset position with respect to the print produced by said first printing station.

Further characteristics and advantages of the invention will become apparent from the following detailed description of a preferred but not exclusive embodiment of the printing machine according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic lateral elevation view of the machine according to the invention;

figure 2 is a schematic top plan view of the machine according to the invention;

figure 3 is a schematic sectional view of figure 2, taken along the plane III-III;

figure 4 is an enlarged-scale view of a detail of the belt-like supporting element of the machine according to the invention;

figures 5 and 6 are diagrams of the operation of the machine according to the invention.

With reference to the above figures, the printing machine according to the invention, generally designated by the reference numeral 1, comprises in a per se known manner a belt-like supporting element 2 controllably movable along an advancement direction 3 and on which the fabric 4 or the like to be printed is arranged and rigidly coupled.

The belt-like supporting element 2 can wind, as in conventional printing machines, around two rollers 5a and 5b with mutually parallel horizontal axes, at least one of which is driven so as to turn intermittently by steps of a preset extent, so as to cause an intermittent advancement of the belt-like supporting element 2.

A first printing station 6 and at least one second printing station 7 are arranged along the extension of the belt-like supporting element 2 and are mutually spaced along the advancement direction 3.

Preferably, several printing stations, designated by the reference numerals 6 to 9 respectively, according to the number of colors required to produce a preset pattern, are arranged along the extension of the belt-like supporting element 2.

According to the invention, the printing machine comprises registration means located on the belt-like supporting element 2 and means for detecting said registration means which are associated with the printing stations 6 to 9. At least the printing stations after the first one, that is to say, the printing stations 7, 8, and 9 shown in the drawings, are controllably movable along the advancement direction 3, in one direction or the other, so as to arrange themselves with respect to the belt-like supporting element 2 according to the detection of the registration means, performed by the detector means, so as to produce, on the fabric 4, a print in a preset position with respect to the print formed by the first printing station 6.

More particularly, the printing stations 7, 8, and 9 comprise a supporting framework 10 that rests slidingly on guides 11a and 11b laterally arranged on opposite sides with respect to the belt-like supporting element 2 and running parallely to the advancement direction 3.

The first printing station 6 can also be mounted on the guides 11a and 11b and is preferably fixed to said guides 11a and 11b, that is to say, so that it cannot slide after a first adjustment positioning.

The registration means according to the invention are conveniently constituted, in the illustrated embodiment, by a band 12 that is fixed to a perimetric side of the belt-like supporting element 2 which is parallel to the advancement direction 3. Said band 12 is provided with notches or holes 13 uniformly mutually spaced along the advancement direction 3.

The detector means according to the invention preferably comprise, as shown, a wheel 14 with teeth 14a that mesh with the notches or holes 13. The framework 10 of the corresponding printing station supports said wheel so that it can rotate about its own axis 15, which is arranged transversely to the advancement direction 3. A detector element 16 is arranged on the shaft of each wheel 14 and is preferably constituted by an encoder that detects the rotation of the wheel 14 about its axis 15.

Each one of the printing stations that is movable along the guides 11a and 11b, that is to say, each one of the printing stations 7, 8, and 9, is provided with a driving element 17, for example an electric motor, the output shaft 17a whereof is connected to a pinion 18 that meshes with a rack 19 rigidly coupled to the guides 11a and 11b and running parallely to the advancement direction 3.

The first printing station 6, too, can be provided with an electric motor 27, the output shaft whereof is connected to a pinion that meshes with the rack 19. The actuation of the motor 27 of the first printing station 6 is not controlled by the detection performed by the detector means but is caused simply by the need to adjust the position of the first printing station 6 along the guides 11a and 11b when printing begins.

The rack 19 can be directly embedded in one of the guides 11a and 11b, and it is also possible to provide a rack for each one of the guides 11a and 11b and two pinions 18, at least one of which is motorized, so as to achieve perfect travel of the framework 10 of each one of the printing stations along the advancement direction 3.

Strictly speaking, the rack 19 might also be omitted and the movement of the printing stations 6 to 9 might be achieved by means of a toothless wheel, instead of the pinion 18, which rests directly on one of the guides 11a and 11b, since any slippage of said wheel does not produce errors in the positioning of the printing stations 6 to 9 with respect to the belt-like supporting element 2, since this positioning is controlled by the detector means.

Conveniently, the various detector elements 16 of the printing stations 6, 7, 8, and 9 are connected to the input of an electronic control unit 20 that supervises the operation of the printing machine. The output of this electronic control unit 20 is connected to the motors 17 of the various printing stations so as to actuate said motors according to the detection performed by the various detector elements 16 of the printing stations, as will become apparent hereinafter.

As an alternative, instead of providing a band 12 with notches or holes 13, it is possible to

provide a band with mutually spaced register marks that can be detected by means of optical detectors, or it is possible to provide a band made of magnetizable material that is included in the belt-like supporting element 2 and bears magnetic register marks. In this last case, the detector means located on the printing stations are constituted by magnetic readers.

The registration means can furthermore be formed directly on the belt-like supporting element 2.

According to another variation, the registration means, instead of being provided beforehand on the belt-like supporting element or on a metallic or magnetic band associated with the belt-like supporting element 2, can be "placed" by a device that is associated with the first printing station and can be activated during the printing operation performed in said station 6. Said device can be constituted by an additional printing device for applying optically detectable register marks, or by a punching device for applying mechanically detectable register marks, or by a magnetic recording head for applying, on the magnetic tape associated with the belt-like supporting element 2, register marks that can be detected by a magnetic reader, depending on the detection means to be used.

The operation of the printing machine according to the invention is as follows.

When it is necessary to print a fabric with patterns A having a step "r", the printing stations 6, 7, 8, and 9 must be mutually spaced with a center distance "s" that is a multiple of the printing step "r", assuming of course that the length of the belt-like supporting element 2 is unchangeable.

Initially, the belt-like supporting element 2 is actuated so as to place a first region A of the fabric at the first printing station 6. During the printing operation performed by the first station 6, the various detectors 16 located on the various printing stations 6, 7, 8, and 9 undergo a sort of reset. Then the belt-like supporting element 2 is moved forward by a step "r", so as to place a second region A to be printed at the first printing station 6; this operation is repeated until the first portion of printed fabric arrives near the second printing station 7. In the illustrated case, in which the printing stations are mutually spaced by an extent "s" that is equal to twice the printing step "r", this occurs when a third region A of the fabric is located at the first printing station 6. At this point, the detector 16 located in the first printing station 6 has detected a travel of the belt-like supporting element 2 that is equal to 2r, and the detector 16 located in the second printing station 7 should also have detected a travel equal to 2r. The two readings, performed respectively by the detector 16 located in the second printing station 7 and by the detector 16 located in the first printing station 6, are sent to the electronic control unit 20 and are compared with each other. If the two read values are identical, while the first printing station 6 performs the third printing stroke the second printing station 7 performs its first printing stroke. If the two read values are not mutually identical, the electronic control unit 20 activates the motor 17 of the second printing station 7 in one direction or the other, so as to increase or decrease the value read by the detector 16 of the second printing station, in order to make it equal to the value read by the detector of the first printing station. When the two values are identical, the second printing station 7 is activated and accordingly performs its first printing stroke. In this manner the print produced by the second printing station 7 is certainly correctly positioned with respect to the print produced by the first printing station 6. The value read by the various detectors 16 located on the stations after the second one is then compared, as already described with reference to the second printing station 7, with the value read by the first printing station 6, so that the prints produced by the other subsequent printing stations are also correctly positioned with respect to the print produced by the first printing station 6 and are thus mutually correctly positioned.

In this manner, the machine is capable of detecting any drifts "c" in the position of a printing station with respect to its correct position as a consequence of possible accidental elongations or shortenings of the belt-like supporting element 2, and can accordingly promptly correct, without manual interventions on the part of the operator, its position with respect to the print produced by the previous printing station or stations.

After machine startup, every time the belt-like supporting element 2 advances by an extent equal to the printing step "r" a reading is taken and the read values are compared.

In practice it has been observed that the printing machine according to the invention fully achieves the intended aim since, by virtue of the fact that it is possible to automatically position the printing stations with respect to the prints produced by previous printing stations, said machine is capable of ensuring high printing precision even in case of accidental variations in the length of the belt-like supporting element.

Another advantage of the printing machine according to the invention is that it avoids continuous manual adjustments that would entail machine stops, thus ensuring high productivity.

The machine thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other

technically equivalent elements.

In practice, the materials employed, as well as the dimensions, may be any according to the requirements and the state of the art.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. Printing machine, particularly for fabrics or the like, with multiple printing stations, comprising: a belt-like supporting element (2), controllably movable along an advancement direction (3), for the fabric (4) or the like to be printed; a first printing station (6) and at least one second printing station (7,8,9) that are mutually spaced along said advancement direction (3); characterized in that it comprises registration means (12) located on said belt-like supporting element (2) and means (14) for detecting said registration means which are associated with said printing stations (6-9); said at least one second printing station (7-9) being controllably movable along said advancement direction (3) so as to position itself with respect to said belt-like supporting element (2) according to the detection of said registration means (12) on the part of said detector means (14) so as to produce, on the fabric (4), a print in a preset position with respect to the print produced by said first printing station (6).

2. Printing machine according to claim 1, characterized in that said at least one second printing station (7-9) is slidingly supported by guides (11a,11b) arranged laterally to said belt-like supporting element (2) parallel to said advancement direction (3).

3. Printing machine according to claims 1 and 2, characterized in that it comprises, after said first printing station (6), a plurality of printing stations (7-9) that are mutually spaced along said advancement direction (3), said printing stations (7-9) being slidingly mounted on said guides (11a,11b), each one of said printing stations being provided with said detector means (14) and being controllably movable along said guides (11a,11b) so as to position itself with respect to said belt-like supporting element (2) according to the detection of said registration means (12) on the part of the corresponding detector means (14), in order to produce prints in succession in a preset position with respect to the print produced by said first printing station (6).

4. Printing machine according to one or more of the preceding claims, characterized in that said first printing station (6) is fixed with respect to said guides (11a,11b).

5. Printing machine according to one or more of the preceding claims, characterized in that each one of said printing stations (7-9) that are movable along said guides (11a,11b) is provided with a drive unit (17) with an output shaft (17a) rigidly coupled to a wheel (18) that rests on one of said guides (11a,11b).

6. Printing machine according to one or more of the preceding claims, characterized in that each one of said printing stations (7-9) that are movable along said guides (11a,11b) is provided with a drive unit (17) with an output shaft (17a) rigidly coupled to a pinion (18) that meshes with a rack (19) that is arranged parallel to said guides (11a,11b).

7. Printing machine according to one or more of the preceding claims, characterized in that said first printing station (6) is provided with a drive unit (27) with an output shaft rigidly coupled to a wheel that rests on one of said guides (11a,11b) and can be actuated to move said first printing station (6) along said guides (11a,11b) for adjustment.

8. Printing machine according to one or more of the preceding claims, characterized in that said detector means (14) comprise detectors that read the length of said belt-like supporting element (2) that travels through the corresponding printing station between two successive printing operations.

9. Printing machine according to one or more of the preceding claims, characterized in that it comprises an electronic control unit (20) the input whereof is connected to the detector means (14) of said first printing station (6) and to the detector means (14) of said printing stations (7-9) that are movable along said guides (11a,11b), so as to compare the readings of the detector means (14) of the movable printing stations (7-9) with the readings of the detector means (14) of said first printing station (6) between two successive printing operations of said first printing station (6); the output of said electronic control unit (20) being con-

nected to the drive unit (17) of said movable printing stations (7-9) so as to move in either direction the movable printing stations (7-9) that have a different reading with respect to the reading performed by said first printing operation between two successive printing operations, so as to make said readings equal prior to printing in said movable printing stations (7-9).

10. Printing machine according to one or more of the preceding claims, characterized in that said registration means (12) comprise a band that is rigidly associated with a perimetric side of said belt-like supporting element (2) that is parallel to said advancement direction (3), uniformly mutually spaced registration notches (13) being provided along said band (12).

11. Printing machine according to one or more of the preceding claims, characterized in that said reference notches (13) are constituted by holes of said band (12).

12. Printing machine according to one or more of the preceding claims, characterized in that said detector means (14) comprise, for each printing station (6-9), a wheel that is rotatably supported by the corresponding printing station along an axis (15) that lies transversely to said advancement direction (3); said wheel (14) meshes with said reference notches (13), and an element for reading the rotation of said wheel is provided.

13. Printing machine according to one or more of the preceding claims, characterized in that said detector element (14) consists of an encoder.

14. Printing machine according to one or more of the preceding claims, characterized in that if there are no variations in the length of said belt-like supporting element (2), said stations (6-9) are mutually spaced by an extent that is equal to a multiple of the printing step.

15. Printing machine according to one or more of the preceding claims, characterized in that said registration means (12) consist of optically readable register marks applied on said belt-like supporting element (2), said detector means (14) being constituted by optical detectors.

16. Printing machine according to one or more of the preceding claims, characterized in that said registration means (12) consist of magnetic register marks applied on a magnetic band that is associated with said belt-like supporting element (2), said detector means (14) being constituted by magnetic readers.

17. Machine according to one or more of the preceding claims, characterized in that said first printing station (6) is provided with means for applying said registration means (12) on said belt-like supporting element (2) or on an element associated with said belt-like supporting element.

18. Method for automatic printing, particularly for fabrics or the like, characterized in that it consists in: rigidly coupling the fabric (4) to be printed onto a beltlike supporting element (2) controllably movable along an advancement direction (3); arranging a plurality of printing stations (6-9) along said belt-like supporting element (2) so that they are mutually spaced along said advancement direction (3); providing registration means (12) on said belt-like supporting element (2); providing each one of said printing stations (6-9) with detector means (16); printing the fabric (4) with the first printing station (6) encountered by the fabric (4) during its motion along said advancement direction (3), reading the position of said registration means (12) at said first printing station (6); producing an advancement of the belt-like supporting element (2) so as to place the produced print proximate to a successive printing station (7); positioning said successive printing station (7) along said advancement direction (3) until the detector means (14) of the subsequent printing station (7) are located at the registration means (12) located by said first printing station (6); and performing a subsequent print.

19. Method according to claim 18, characterized in that said registration means (12) are applied on said beltlike supporting element (2), or on an element associated with said belt-like supporting element (2), by a device that is arranged on said first printing station (6) and can be activated when said first printing station (6) produces its print.

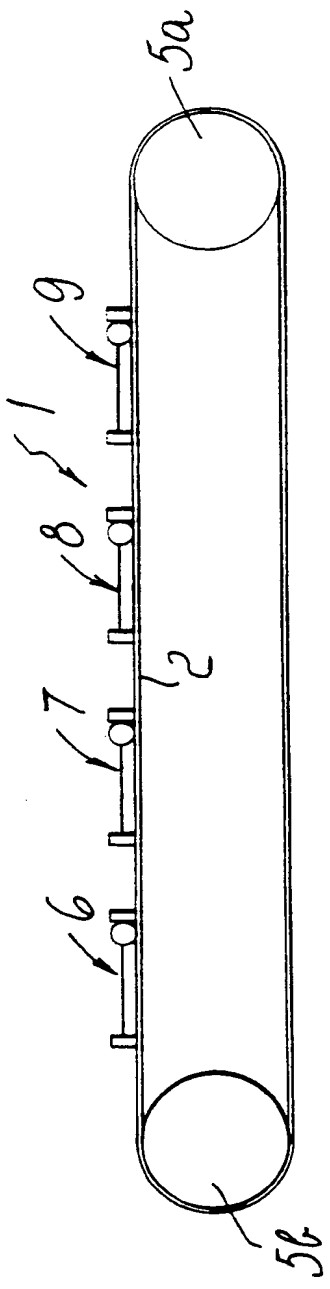

Fig. 1

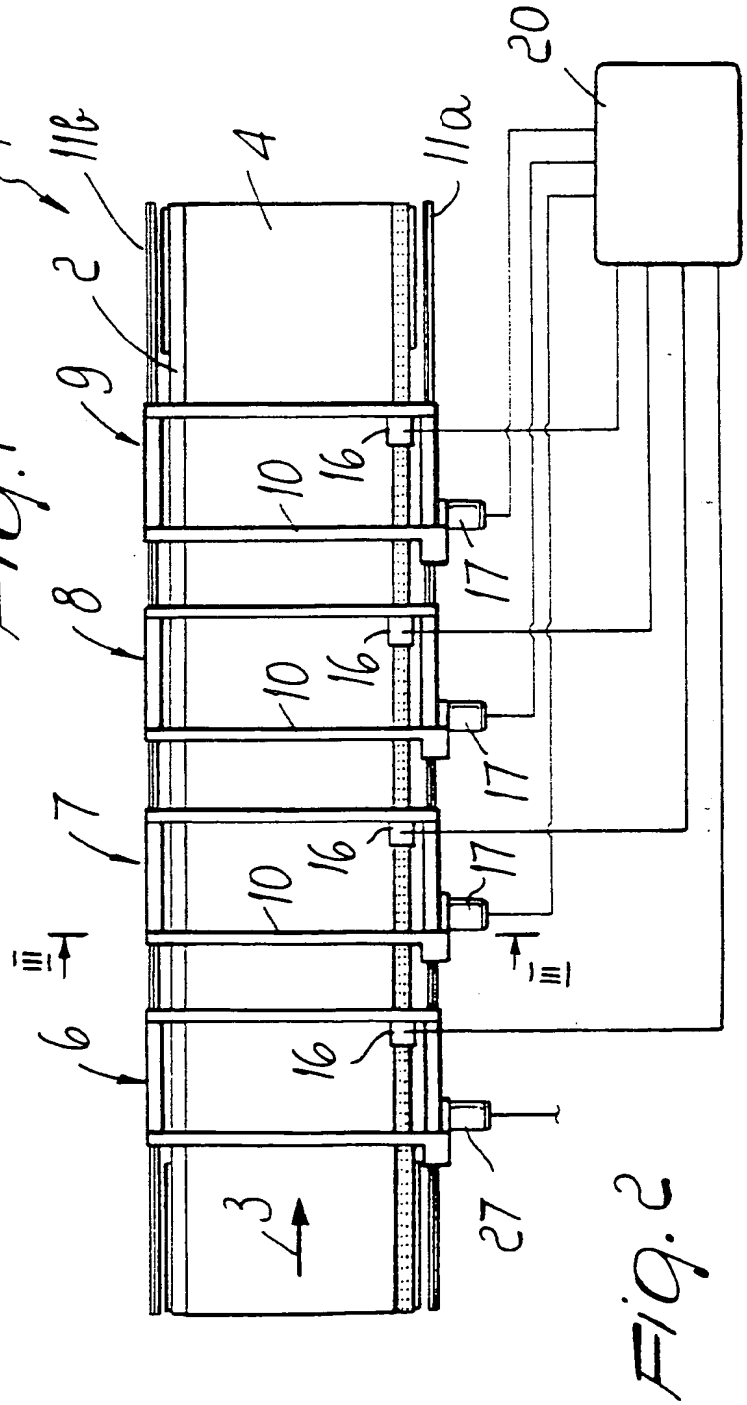

Fig. 2

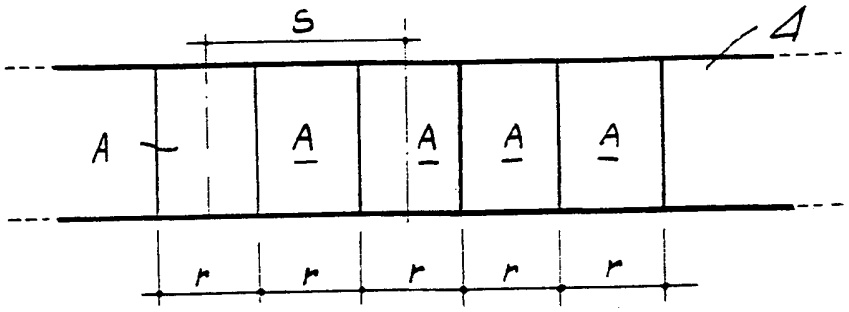

FIG. 5

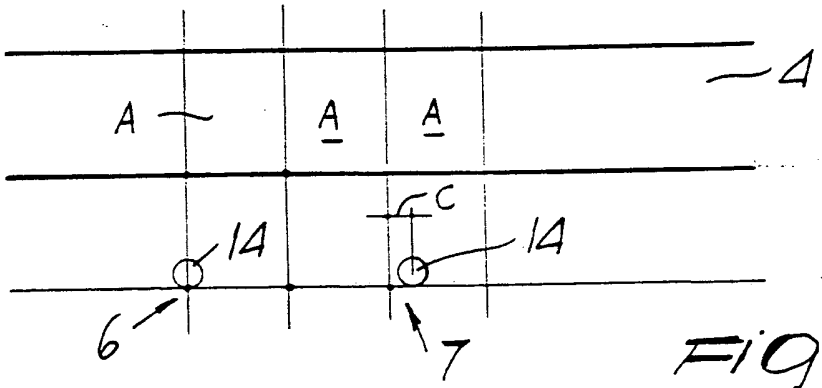

FIG. 6

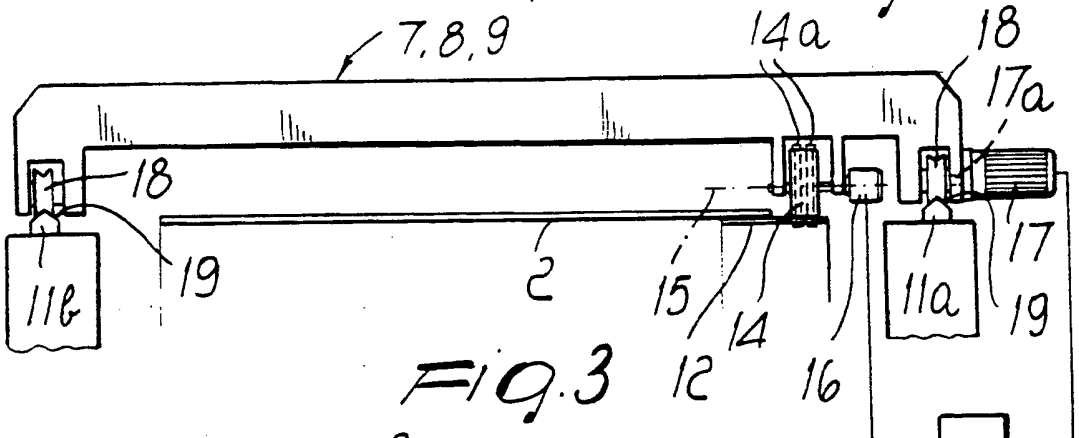

FIG. 3

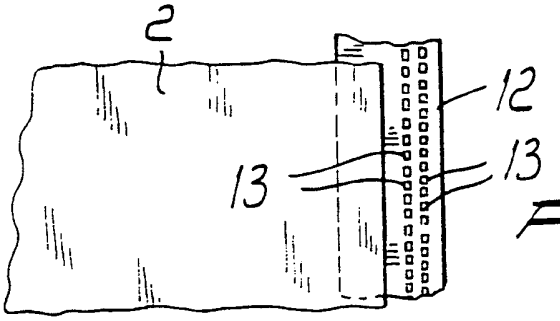

FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 10 7148

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US-A-4 084 505 (ICHINOSE) * the whole document * ---	1-3,14, 15,18 10-12	B41F17/00 B41F15/10
Y	EP-A-0 242 846 (MS MACCHINE E SISTEMI S.R.L.) * the whole document * ---	10-12	
X	EP-A-0 364 424 (SVECIA SILKSCREEN MASKINER AB) * the whole document * ---	1,8, 14-16,18	
X	FR-A-2 397 943 (REGGIANI S.P.A.) * the whole document * ---	1-3,6,8, 14,15	
X	PATENT ABSTRACTS OF JAPAN vol. 18 no. 206 (M-1591) ,12 April 1994 & JP-A-06 008395 (TOSHIN KOGYO KK) 18 January 1994, * abstract * ---	1,17	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 10 no. 21 (M-449) ,28 January 1986 & JP-A-60 179256 (TSUJI SENSHIYOKU KK) 13 September 1985, * abstract * -----	1	B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 September 1995	DIAZ-MAROTO, V

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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